# ELECTRICAL SAFETY FOR AFE II-t

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## Abstract

This memo addresses issues relevant to the safe operation of the AFE II-t. The AFE II-t has the same mechanical and electrical connections as the AFE I and connect to the same supplies, but uses less power and the fuses are the same or smaller compared to AFE I boards. Therefore, the AFE II-t boards should be safe to operate under the same rules as AFE Ic.

## Overview

The AFE is 14.435 inches high by 19.25 inches wide. It is a bare circuit board with no front panel. Components are mounted on both sides. Due to mechanical restrictions, component height above the board may be no more than 0.431" on the component side and no more than 0.050" on the solder side. Twelve layer FR4 construction is used and boards are built to IPC Class3 standard. Boards have handles attached to the front for use in mounting on the cryostat. AFE II-t boards are pin compatible with AFE I boards and require no modifications to any external systems. The use the same power, at the same voltages, distributed through the same backplane. VLPC signals from the cryostat are connected to the board along the bottom edge using cin:apse connectors. No other cables are connected directly to the boards- the readout cables for trigger and analog readout are connected to the backplane, and the AFE II-t boards have identical connections to the backplanes as the AFE I boards.

## Power Requirements

The AFE II-t measurements indicate a power consumption of about 36.5 Watts split between +5.5V, +5V, +3.3V, and ±12V. To compute power we used worst case conditions assuming maximum current and maximum voltage for a given supply (5.5V for +5V supply, 3.6V for 3.3V supply , 6V for +5.5V and 13V for ±12V). Below Table1 shows current draw for existing AFE I boards in the Dzero detector. Table 2 shows the current draw for AFEII-t prototypes. Table 3 shows the fuses install on AFE I boards currently operating in the Dzero detector and those installed on the AFEII-t prototypes.

| **Voltage** | **Current Required per board** | **Actual measured current per backplane** | **Current available from PS per backplane** | **Power dissipation per AFE I board (rounded up)** |
|---|---|---|---|---|
| +5 Volts | 2.75 Amps | 22 Amps | 40 Amp | 14 Watts |
| +5.5 Volts | 2.125 Amps | 17 Amps | 20 Amps | 13 Watts |
| ±12 Volts | 0.5 Amps | 4 Amps | 6 Amps | 6 Watts |
| +3.3 Volts | 4 Amps | 32 Amps | 40 Amps | 13.5 Watts |
| Total | | | | 46.5 Watts |

**Table 1 AFE I power consumption (taken from note A991117A)**

| **Voltage** | **Current Required per board** | **Current per backplane (estimated)** | **Current available from PS per backplane** | **Power dissipation per AFE II board (rounded up)** |
|---|---|---|---|---|
| +5 Volts | 1.7 Amps | 14 Amps | 40 Amp | 10 Watts |
| +5.5 Volts | 1.8 Amps | 15 Amps | 20 Amps | 12 Watts |
| ±12 Volts | 0.5 Amps | 4 Amps | 6 Amps | 6 Watts |
| +3.3 Volts | 2.3 Amps | 20 Amps | 40 Amps | 9 Watts |
| Total | | | | 37 Watts |

**Table 2 estimates based on testing of the AFE II-t prototypes.**

| **Voltage** | **AFE II-t fuse** | **AFE I fuse** |
|---|---|---|
| +5 Volts | 5 Amp | 7 Amp |
| +5.5 Volts | 5 Amp | 5 Amp |
| +12 Volts | 2 Amp | 2 Amp |
| -12 Volts | 1 Amp | 2 Amp |
| +3.3 Volts | 5 Amp | 7 Amp |

**Table 3. Fuse comparison for AFE I vs AFE II-t**